

GLP-1 RA and Muscle Health

GLP-1RA and Muscle Health

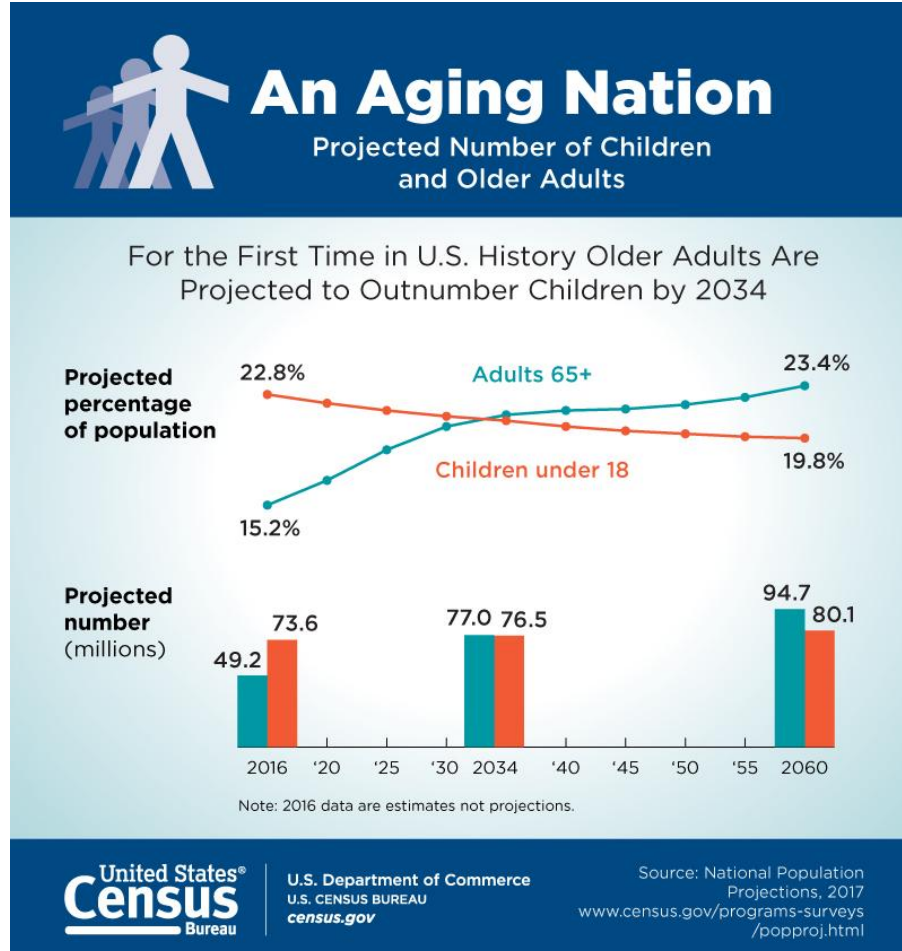
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 - Department of Geriatrics; University of North Dakota
- Research agenda
 - Topics related to aging and health



GLP-1RA and Muscle Health

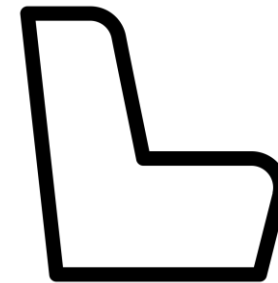
- Objectives
 - Present how musculoskeletal health could be screened and monitored for persons taking a GLP-1RA
 - Describe some challenges for achieving physical activity guidelines
 - Promote musculoskeletal health awareness for persons taking a GLP-1RA

GLP-1RA and Muscle Health



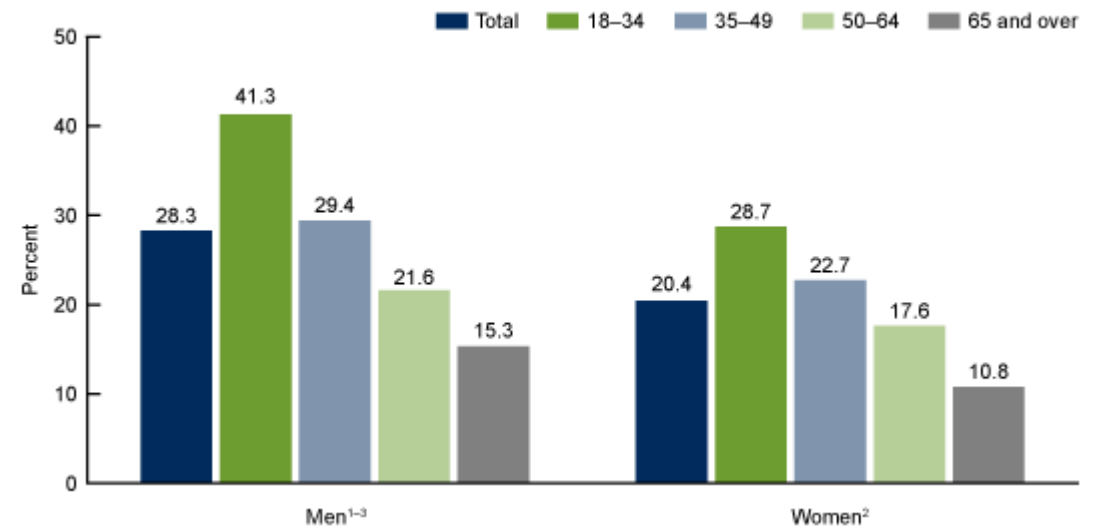
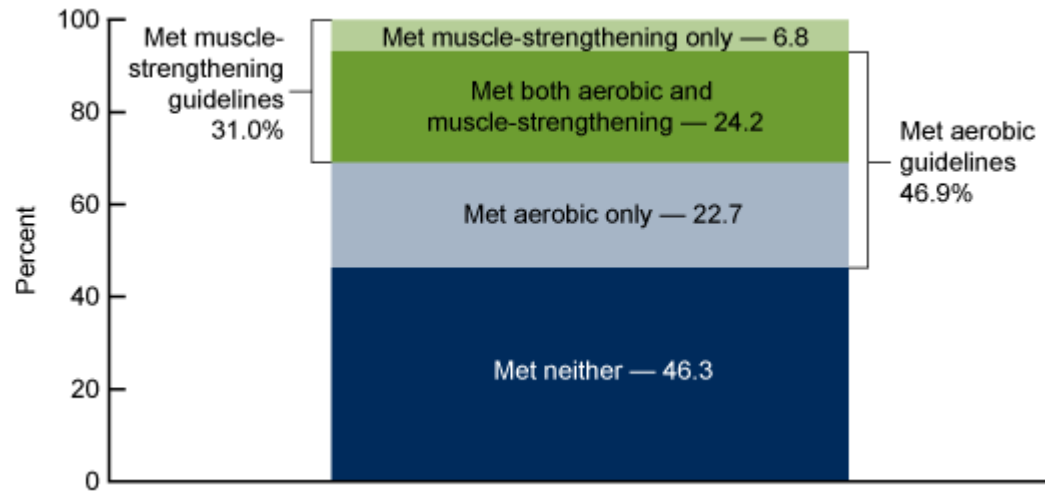
GLP-1RA and Muscle Health

- Physical activity
 - Any bodily movement produced by skeletal muscles that results in energy expenditure (kcal)
- Sedentary behavior
 - Any waking behaviors characterized with a low energy expenditure such as sitting, reclining, or lying
- Physically inactive
 - Not achieving Physical Activity Guidelines



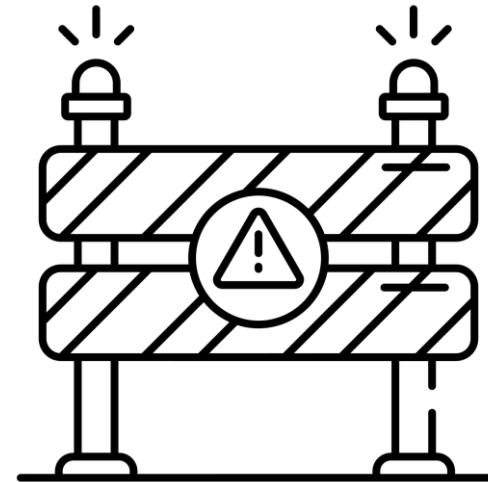
GLP-1RA and Muscle Health

- Dietary recommendations
 - 12.3% met fruit intake recommendations
 - 10.0% met vegetable intake recommendations
- Physical activity guidelines

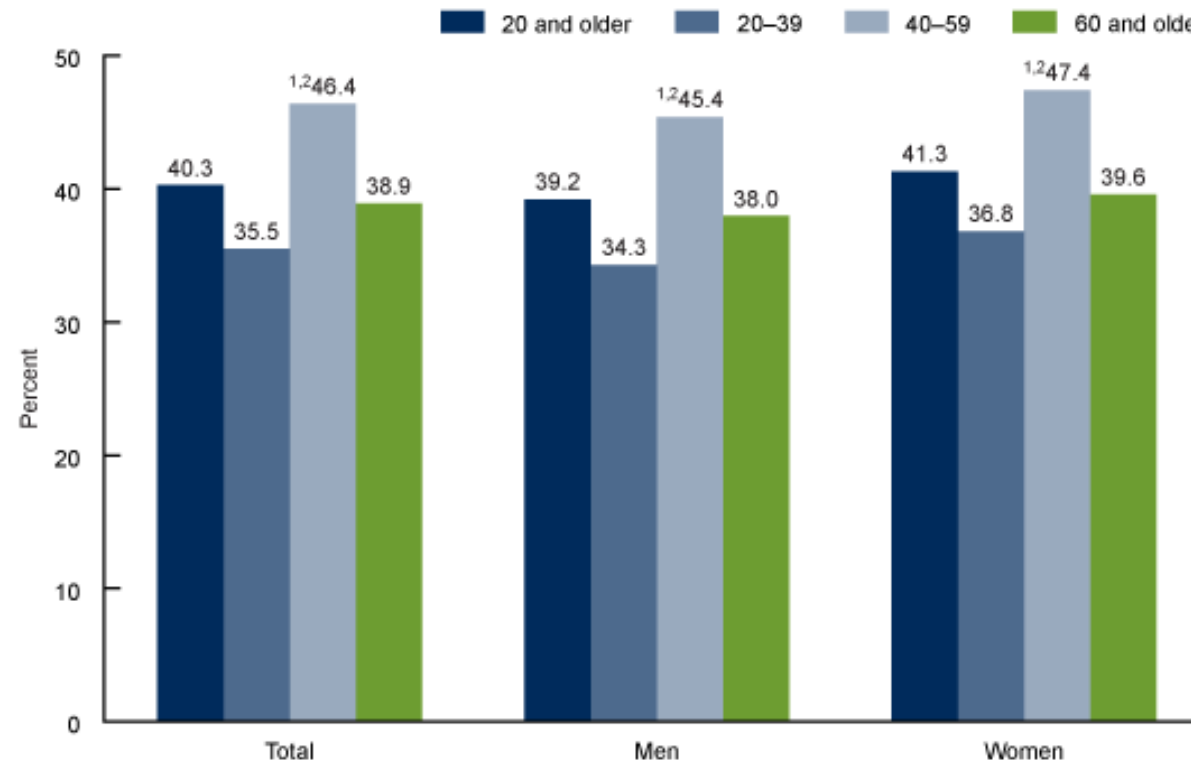


GLP-1RA and Muscle Health

- Common barriers
 - Time
 - Social support
 - Energy
 - Motivation
 - Injury risk
 - Skill and motor development
 - Costs
 - Facility access
 - Weather



GLP-1RA and Muscle Health

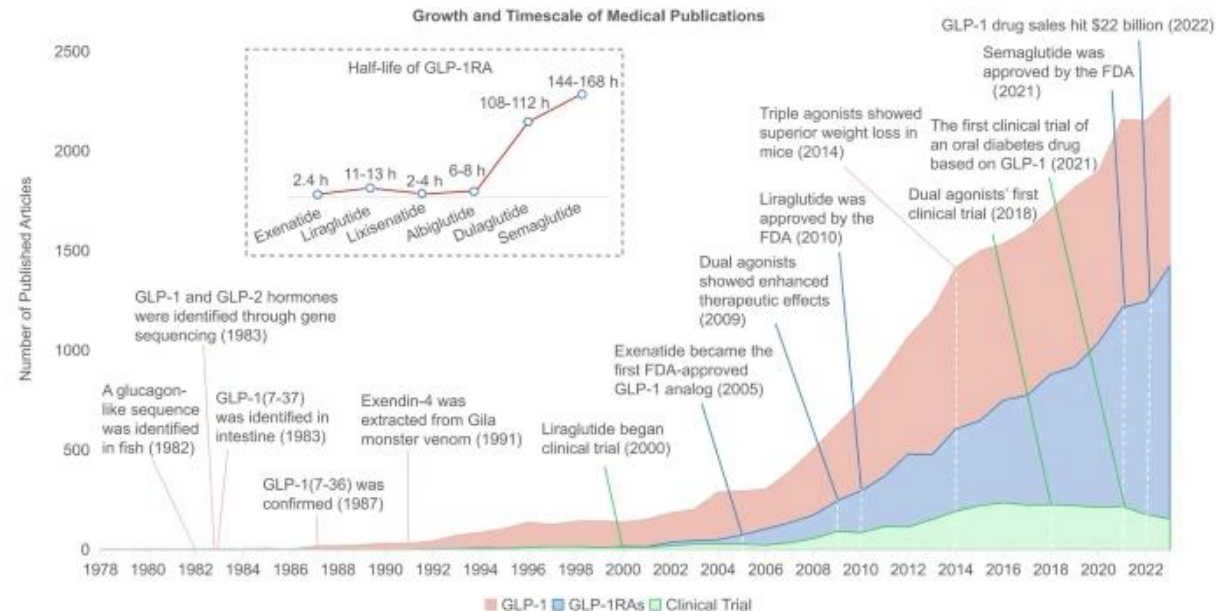


GLP-1RA and Muscle Health

- GLP-1R
 - Present on the surfaces of many cells in the body (part of G protein-coupled receptor family)
- GLP-1
 - Hormone that regulates blood glucose levels and lipid metabolism
 - GLP-1R can bind to GLP-1
- GLP-1RA
 - Mimic the action of endogenous GLP-1, activating GLP-1R
 - Engages insulin secretion, inhibits glucagon release, delay gastric emptying, presents appetite suppression

GLP-1RA and Muscle Health

- Glucagon like peptide-1 receptor agonists (GLP-1RA)
 - Class of medications often used to treat type II diabetes and obesity
 - Adverse effects may include, for example, nausea, vomiting, diarrhea
 - Adverse effects may lead to a discontinuation rate at about 10%
 - Can promote weight loss



Collins et al. (2024);
Zheng et al. (2024);
Moiz et al. (2025)

Table 1. Prescription Process Characteristics Among Websites Selling Online GLP-1 RAs

Table 1. Prescription Process Characteristics Among Websites Selling Online GLP-1 RAs				
	No. (%)	Websites that prescribed a GLP-1 RA		Websites that denied prescription (n = 4)
Characteristics	All websites (N = 49)	Compounded (n = 39)	Branded (n = 6)	
Medications sold				
Compounded GLP-1 RA	44 (89.8)	39 (100)	1 (16.7)	4 (100)
Branded GLP-1 RA	32 (65.3)	23 (59.0)	6 (100)	3 (75.0)
Compounded and branded GLP-1 RAs	27 (55.1)	23 (59.0)	1 (16.7)	3 (75.0)
Generic liraglutide	5 (10.2)	3 (7.7)	2 (33.3)	0
Questions from questionnaires and calls ^a				
Used questionnaire	49 (100)	39 (100)	6 (100)	4 (100)
Height and weight	49 (100)	39 (100)	6 (100)	4 (100)
Medical conditions	48 (98.0)	39 (100)	5 (83.3)	4 (100)
Any medications and allergies	46 (93.9)	37 (94.9)	5 (83.3)	4 (100)
Contraindications ^b	45 (91.8)	36 (92.3)	5 (83.3)	4 (100)
Warnings and precautions ^c	44 (89.8)	35 (89.7)	5 (83.3)	4 (100)
Weight loss goals	39 (79.6)	31 (79.5)	5 (83.3)	3 (75.0)
Surgical history	39 (79.6)	32 (82.1)	4 (66.7)	3 (75.0)
Prior nonpharmacological weight loss attempts	32 (65.3)	25 (64.1)	4 (66.7)	3 (75.0)
Diet and physical activity	26 (53.1)	22 (56.4)	2 (33.3)	2 (50.0)
Eating disorders	27 (55.1)	22 (56.4)	3 (50.0)	2 (50.0)
Personalizing compounded GLP-1 RAs ^d	22 (44.9)	20 (51.3)	0	2 (50.0)
Tobacco/nicotine or alcohol use	19 (38.8)	16 (41.0)	2 (33.3)	1 (25.0)
Last medical evaluation	19 (38.8)	14 (35.9)	2 (33.3)	3 (75.0)
Request for blood pressure, glucose, cholesterol, or triglyceride values	18 (36.7)	14 (35.9)	2 (33.3)	2 (50.0)
Having a primary care clinician	9 (18.4)	9 (23.1)	0	0
No. of questions, median (IQR)	24 (19-33)	26 (21-33)	18 (17-21)	27 (17-36)
Payment				
Payment information before prescription	43 (87.8)	34 (87.2)	6 (100)	3 (75.0)
Payment transaction before prescription	32 (65.3)	24 (61.5)	5 (83.3)	3 (75.0)
Identity verification				
License, passport, or social security number	35 (71.4)	28 (71.8)	4 (66.7)	3 (75.0)
Photo of face	13 (26.5)	10 (25.6)	3 (50.0)	0
Upper-body photo	1 (2.0)	1 (2.6)	0	0
Full-body photo	11 (22.4)	8 (20.5)	1 (16.7)	2 (50.0)
Photo standing on a scale	2 (4.1)	1 (2.6)	1 (16.7)	0

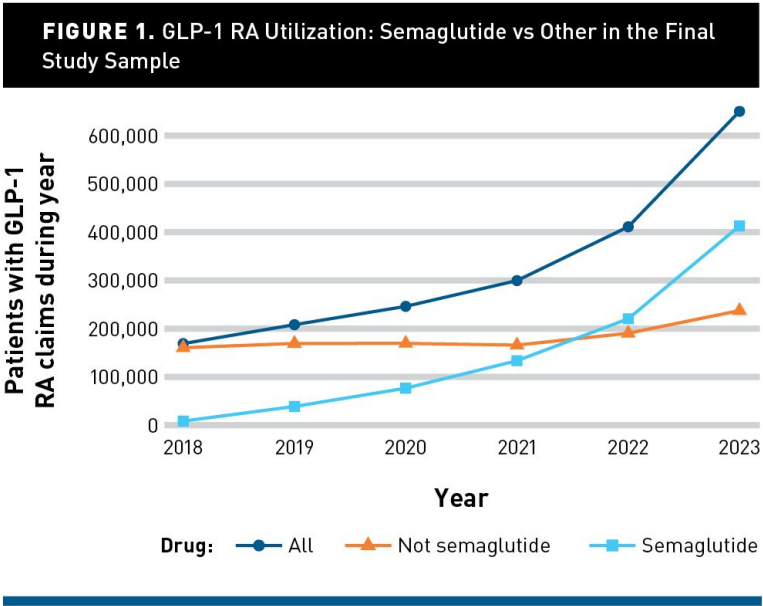
Table 2. Characteristics of GLP-1 RAs Prescribed by Online GLP-1 RA Sellers

Characteristics	GLP-1 RAs, No. (%) [N = 45]
Compounded semaglutide/tirzepatide	39 (86.7)
Branded semaglutide/tirzepatide	6 (13.3)
Formulation ^a	
Subcutaneous	39 (86.7)
Sublingual	5 (11.1)
Oral	1 (2.2)
Supplements ^b	
Added any supplement	27 (60.0)
Vitamin B ₁₂	15 (33.3)
Vitamin B ₆	5 (11.1)
Vitamin B ₃ or NAD ⁺	4 (8.9)
Glycine	7 (15.6)
Carnitine	2 (4.4)
GLP-1 RA prescribed with upper-body photo despite requiring full-body photo or photo on a scale ^c	9 (20.0)
Automatically charged and shipped medication after prescription approval ^d	34 (75.6)
Clinician video visit or call duration, median (IQR), min ^e	9 (6.3-9.8)

TABLE 1. Diabetes Indication and Obesity Status Among GLP-1 RA Users by Year

Characteristic	2018	2019	2020	2021	2022	2023
Number of observations	169,188	208,402	246,345	299,806	411,276	650,648
Study groups, n (%)						
Diabetes indication	150,710 (89%)	185,499 (89%)	218,970 (89%)	256,860 (86%)	317,486 (77%)	431,668 (66%)
Group 1: not obese/overweight	86,302 (51%)	104,887 (50%)	130,283 (53%)	144,412 (48%)	171,318 (42%)	301,180 (46%)
Group 2: obese/overweight	64,408 (38%)	80,612 (39%)	88,687 (36%)	112,448 (38%)	146,168 (36%)	130,488 (20%)
No diabetes indication	18,478 (11%)	22,903 (11%)	27,375 (11%)	31,690 (11%)	93,790 (23%)	218,980 (34%)
Group 3: not obese/overweight	7599 (4.5%)	9439 (4.5%)	11,923 (4.8%)	15,845 (5.3%)	32,106 (7.8%)	107,786 (17%)
Group 4: obese/overweight	10,879 (6.4%)	13,464 (6.5%)	15,452 (6.3%)	27,101 (9.0%)	61,684 (15%)	111,194 (17%)

GLP-1 RA, glucagon-like peptide 1 receptor agonist.



Ukhanova et al. (2025)

GLP-1 RA, glucagon-like peptide 1 receptor agonist.

TABLE 2. Descriptive Statistics for Groups Based on Obesity and Diabetes Indication

Characteristic	(1) Diabetes indication: not obese/overweight n = 938,382	(2) Diabetes indication: obese/overweight n = 622,811	(3) No diabetes indication: not obese/overweight n = 184,698	(4) No diabetes indication: obese/overweight n = 239,774	P
Age group in years, n (%)					< .001 ^a
18-34	23,617 (2.5%)	28,916 (4.6%)	22,195 (12%)	35,295 (15%)	
35-44	92,820 (9.9%)	83,979 (13%)	47,578 (26%)	66,020 (28%)	
45-54	260,994 (28%)	187,514 (30%)	65,371 (35%)	81,754 (34%)	
55-64	402,072 (43%)	242,810 (39%)	43,915 (24%)	51,716 (22%)	
65-74	111,027 (12%)	56,670 (9.1%)	4845 (2.6%)	4343 (1.8%)	
≥ 75	47,852 (5.1%)	22,922 (3.7%)	794 (0.4%)	646 (0.3%)	
Age in years, median (IQR)	57 (50-63)	55 (47-61)	48 (40-55)	47 (39-54)	< .001 ^b
Sex, n (%)					< .001 ^a
Female	475,563 (51%)	353,035 (57%)	146,966 (80%)	193,414 (81%)	
Male	462,819 (49%)	269,776 (43%)	37,732 (20%)	46,360 (19%)	
Insurance, n (%)					< .001 ^a
Commercial	811,365 (86%)	547,887 (88%)	181,137 (98%)	235,901 (98%)	
Medicare Advantage	127,017 (14%)	74,924 (12%)	3561 (1.9%)	3873 (1.6%)	

GLP-1RA and Muscle Health

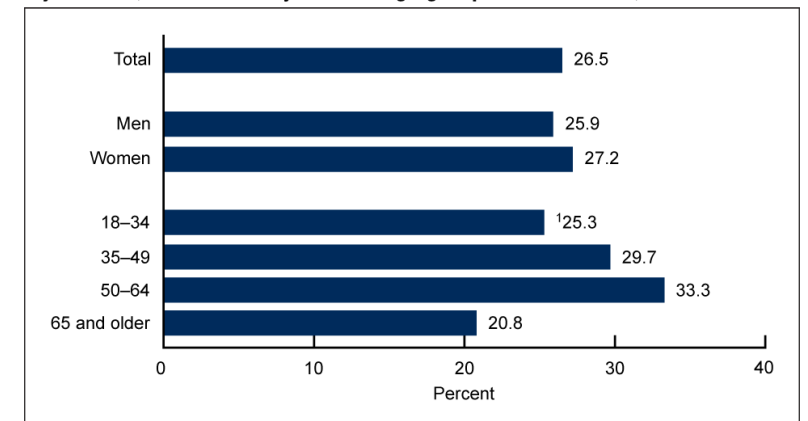
- Glucagon like peptide-1 receptor agonists (GLP-1RA)

- Show promise for reducing body weight/mass
- Rapid increase in use
- Age group and GLP-1RA usage
- Risks could be present

- Musculoskeletal health

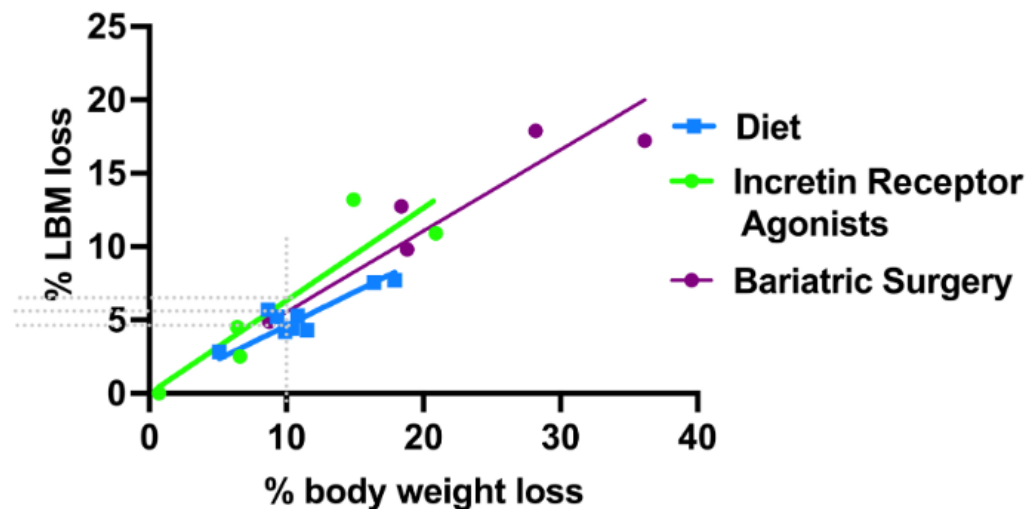
- Rapid weight reduction could be linked to losses in lean body mass
- In some, up to 40% of overall weight loss is attributed to lean body mass
- Persons with obesity may have greater muscle mass; loss of muscle mass may occur during weight loss
 - Adaptive vs maladaptive muscle response

Figure 1. Percentage of adults with diagnosed diabetes who used GLP-1 injectables, overall and by sex and age group: United States, 2024

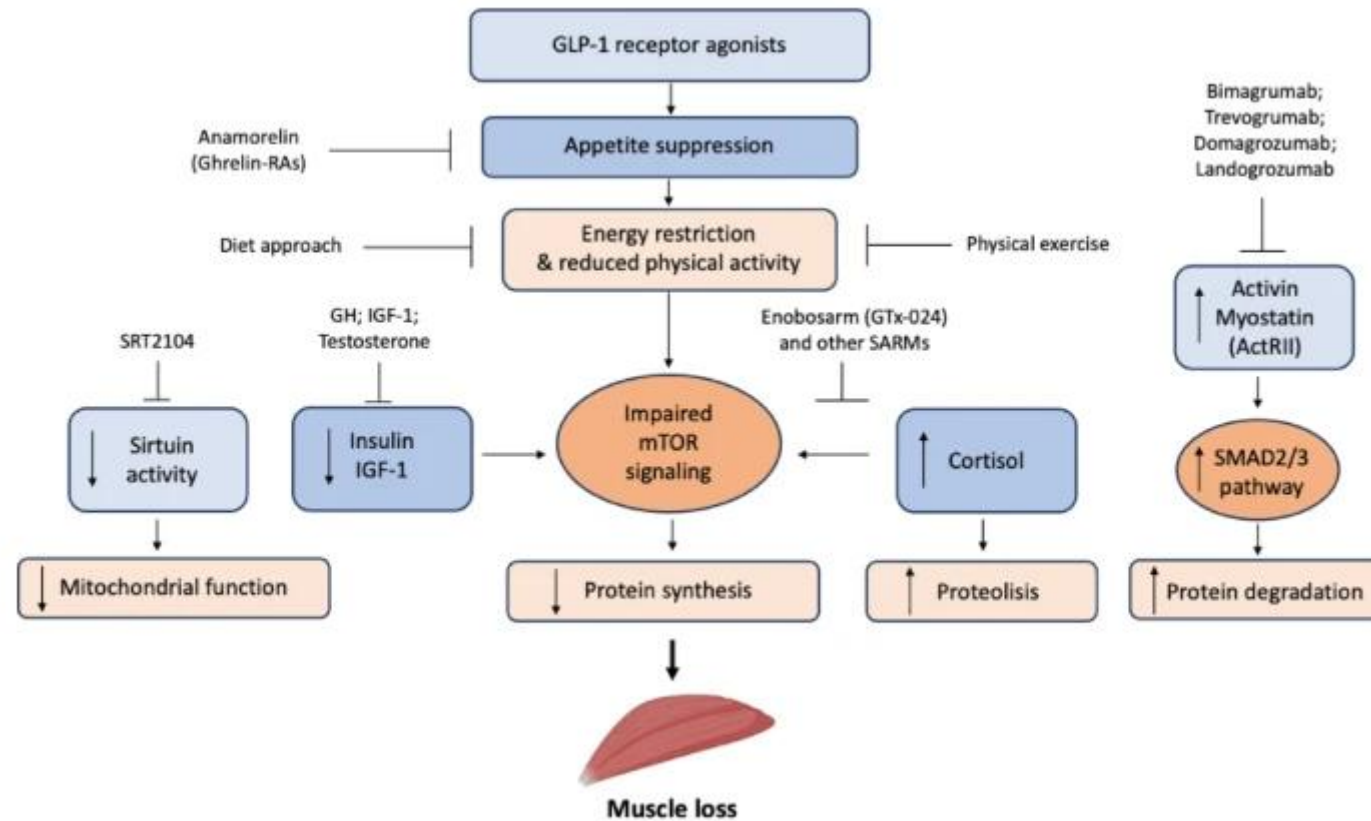


GLP-1RA and Muscle Health

- GLP-1RA
 - Certain aspects could provide insights
 - Semaglutide (Ozempic) and tirzepatide (Mounjaro) would be linked to muscle atrophy relative to all other drugs in the FDA Adverse Event Reporting System
 - Weight regain after rapid weight loss
 - Ability to restore lost muscle mass after rapid weight loss?



GLP-1RA and Muscle Health



GLP-1RA and Muscle Health

- GLP-1RA
 - Longer-term health implications (muscle health)
 - Atrophy
 - Muscle tissue loss
 - Sarcopenia
 - Age-related loss of muscle mass (and sometimes strength/function)
 - Sarcopenic obesity
 - Inclusion of obesity
 - Malnourishment
 - Biological and environmental factors

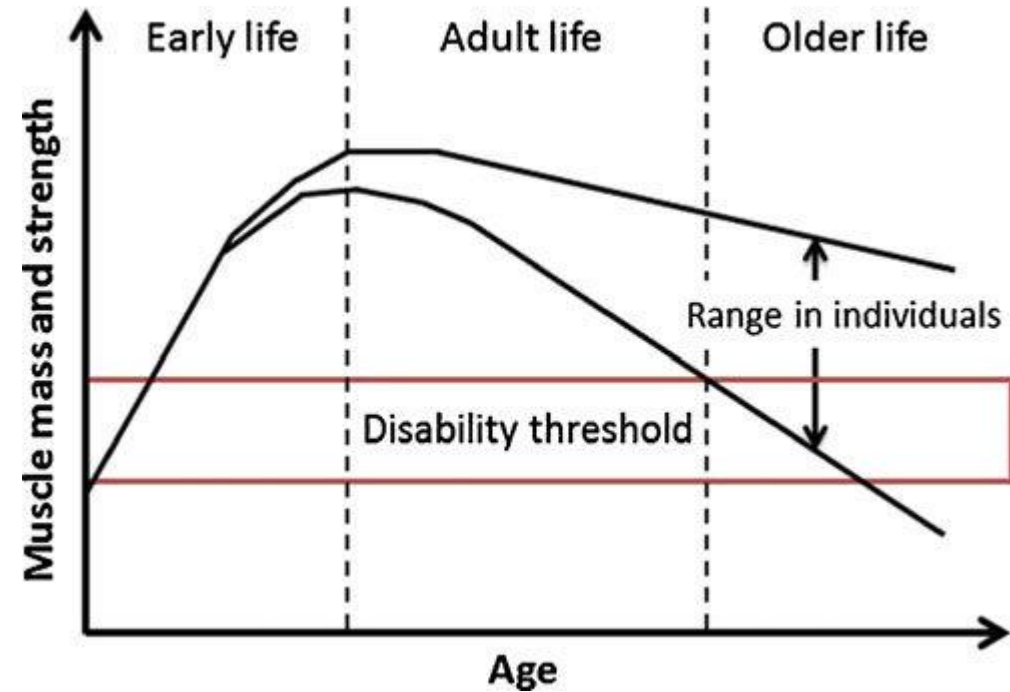
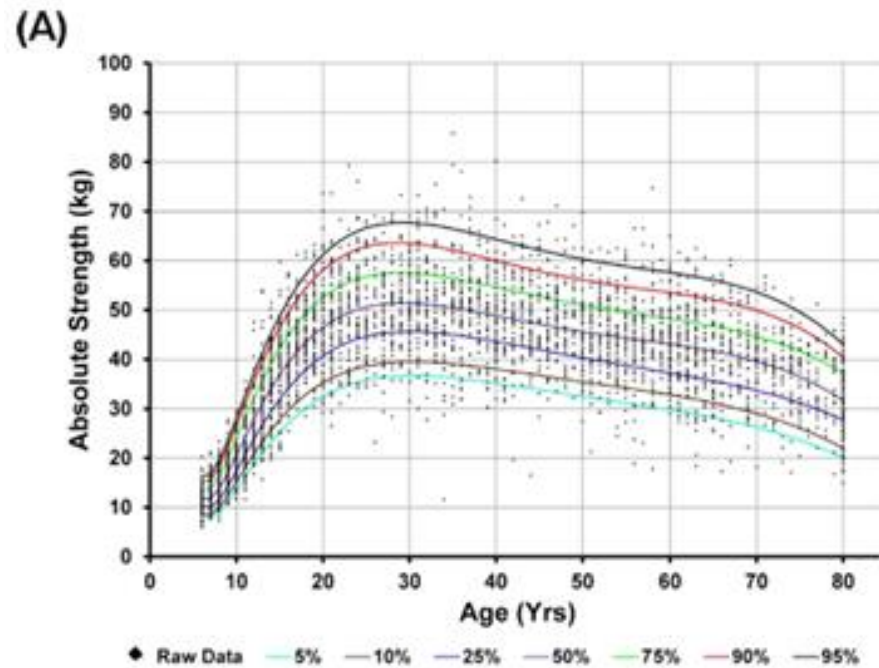
Summary of Strength of Evidence for Sarcopenia Outcomes				
Outcome	Reduced Physical Performance / Mobility Limitation	-	+	++
	Reduced ADL	-	-	++
	Reduced IADL	-	+	++
	Reduced HRQoL	++	++	++
	Increased Risk of Falls	++	++	++
	Increased Risk of Fractures	++	++	++
	Increased Prevalence of Sarcopenia in Hospitalization	+	NA	++
	Increased Risk of Hospitalization	-	++	NA
	Increased Risk of Nursing Home Admission	-	+	+
	Increased Risk of Mortality	++	++	++
	Meta-syntheses	Longitudinal Studies	Cross-sectional Studies	
	Type of Study			

[Drucker \(2025\)](#); [Ghusn et al. \(2024\)](#);
[Beaudart et al. \(2025\)](#); [Prado et al. \(2024\)](#)

GLP-1RA and Muscle Health

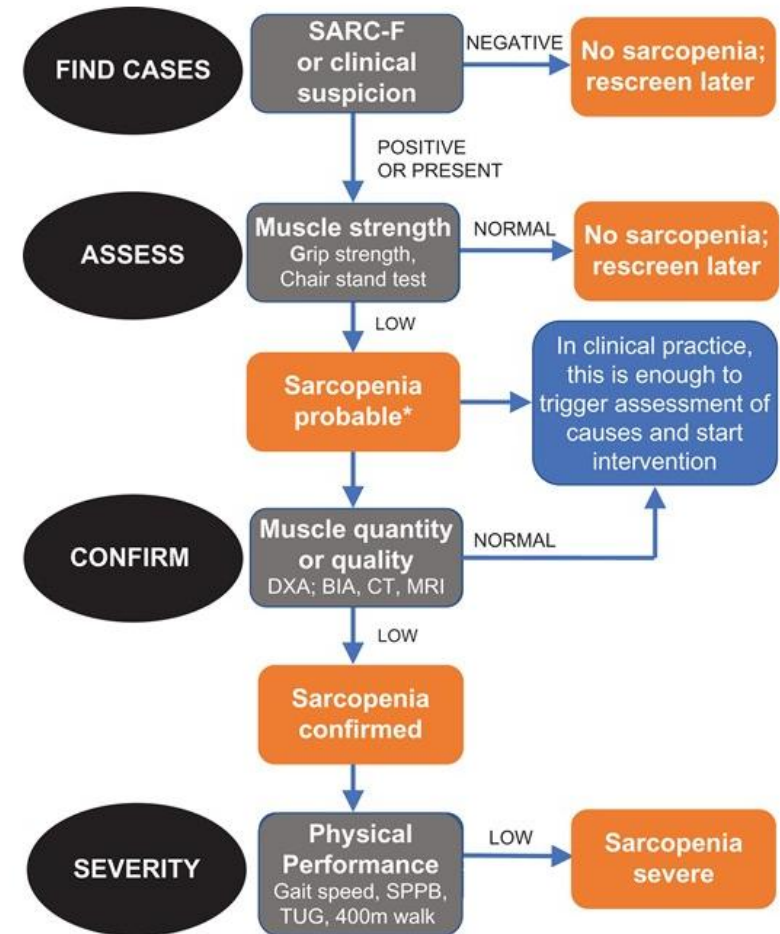
- Muscle health during aging
 - Age-related peak and declines
 - Metabolic function
 - Functional preservation
 - Acute and chronic stressors
 - Physical activity and nutrition remain important lifestyle behavior for preserving muscle mass and strength during aging

GLP-1RA and Muscle Health



GLP-1RA and Muscle Health

- Sarcopenia screening
 - Handgrip strength
 - Muscle mass
 - Physical performance



GLP-1RA and Muscle Health

- Sarcopenia screening
 - Handgrip strength
 - Geriatric M's
 - Muscle mass
 - Physical performance



GLP-1RA and Muscle Health

- Handgrip strength
 - Convenient and reliable
 - Easy to use
 - Simple to learn
 - Private
 - Inclusive
 - Clinical conversations
 - Cut-points and percentiles exist



GLP-1RA and Muscle Health

- Example for measuring handgrip strength
 - Chair with back and arm rests
 - Feet flat
 - Explain and demonstrate
 - Adjust to hand size
 - Squeeze and exhale
 - Record measures
 - Alternate for 2-3 trials
 - Highest recorded measure is often included

GLP-1RA and Muscle Health

- Sarcopenia screening
 - Handgrip strength
 - **Muscle mass**
 - Physical performance



GLP-1RA and Muscle Health

- Sarcopenia screening
 - Handgrip strength
 - Muscle mass
 - Physical performance
 - Mobility related tasks
 - Gait speed
 - Chair stands
 - TUG
 - Basic self-care



GLP-1RA and Muscle Health

	n=35
Muscle Health Concern	4.2±2.7
Bone Health Concern	4.2±2.9
Healthcare Provider Muscle Disease Discussion (n (%))	
Always	0 (0.0)
Often	3 (8.6)
Sometimes	9 (25.7)
Never	23 (65.7)
Healthcare Provider Bone Disease Discussion (n (%))	
Always	0 (0.0)
Often	3 (8.6)
Sometimes	7 (20.0)
Never	25 (71.4)
Healthcare Provider Handgrip Strength Measure (n (%))	
Always	0 (0.0)
Often	0 (0.0)
Sometimes	2 (5.7)
Never	33 (94.3)
Healthcare Provider Muscle Mass Measure (n (%))	
Always	2 (5.7)
Often	0 (0.0)
Sometimes	3 (8.6)
Never	30 (85.7)
Healthcare Provider Gait Speed Measure (n (%))	
Always	0 (0.0)
Often	0 (0.0)
Sometimes	1 (2.9)
Never	34 (97.1)

Note: Results are presented as mean±standard deviation or frequency (percentage) where appropriate. Findings presented as mean±standard deviation were scored on a 10-point Likert scale.

GLP-1RA and Muscle Health

- GLP-1RA
 - Possible importance of physical activity (e.g., resistance training) and nutrition when taking a GLP-1RA for muscle health
 - Awareness for short- and long-term musculoskeletal health
 - Patient and healthcare provider discussions
 - Measures of muscle health
 - Other health-related connections could be crucial (e.g., RD)
 - Considerations for risks-benefits

GLP-1RA and Muscle Health

- Case report
 - Patient
 - 59 year old male
 - Medical history
 - Type II diabetes and sedentary lifestyle
 - Therapy
 - Started GLP-1RA about 6 months ago for weight management and glycemic control
 - Matter
 - Rapid weight reduction of 35 lbs. But complains of challenges standing from a chair, fatigue, and feeling of frailty
 - Assessments
 - Notable reductions in body weight, lean body mass, and physical function (handgrip strength, chair stands)

GLP-1RA and Muscle Health

- True or False: Approximately 40% of American adults are classified as obese based on their body mass index

GLP-1RA and Muscle Health

- True or False: Approximately 40% of American adults are classified as obese based on their body mass index
- True or False: Handgrip strength can be used as a convenient and reliable measure of overall muscle strength

GLP-1RA and Muscle Health

- True or False: Approximately 40% of American adults are classified as obese based on their body mass index
- True or False: Handgrip strength can be used as a convenient and reliable measure of overall muscle strength
- True or False: Glucagon like peptide-1 receptor agonists are a classification of medications often used to treat type II diabetes and obesity

GLP-1RA and Muscle Health

Thank you!

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